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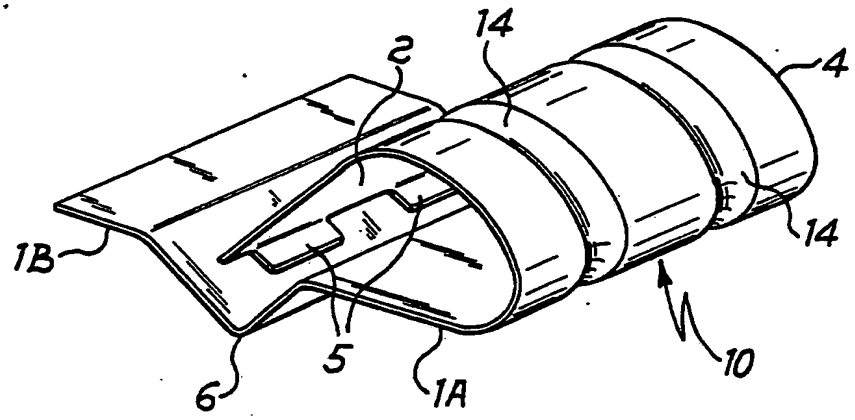

(57) Abstract

Electromagnetic shielding device between housing parts for electronic equipment, formed by a contact spring with two legs (1, 2) which embrace in an elastic way the edge of one of the housing members, positioning itself permanently by means of at least one flap (5) created and sharply bent-in on one leg, which engages in an aperture provided in the housing member. The legs (1, 2) are connected by a portion (4) formed by a circumference arc of more than 180°, and one of the said legs (1) is substantially longer than the other (2) forming a recess inside of which the laps (5) of the other leg abut when the spring is at rest, in order to obtain a preload of the spring.

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ELECTROMAGNETIC SHIELDING DEVICE

Technical Field

The present invention concerns an electromagnetic shielding device for cabinets of electronic equipment, in particular cubicles, racks, housings and similar, provided with at least one openable element, such as e.g. a shutter, a door, a gate, a covering panel, etc.

Further the invention will be illustrated with reference to a favourite application on cabinets for telecommunication equipment, but this should not be understood in a limiting sense as the invented device can be applied to numerous other equipments where the realization of a shielding against transmitted or received electromagnetic interference is necessary like in portable radio equipment.

Industrial Applicability

In general this type of devices consists of elastic elements or springs, and such springs are fixed along the edges of the opening destined to be closed by shutters, or more in general the non airtight parts, in order to guarantee the electrical contact between the parts, and consequently an efficient shielding. The dimensions and the number of such devices depend on the characteristics of the required shielding, and, in particular in telecommunication equipment operating at very high frequencies, the number of such devices per length unit is considerable.

Background Art

There is an electromagnetic shielding device between parts of housing for electric equipment already known, which consists of a contact spring with a triangular isosceles profile, which opening corresponds to a summit with at least one in bent flap.

Such spring has to be inserted in such a way that it clasps the edge of one of the housing parts, fitting permanently by means of the flap engaging in an aperture provided in the housing member, and with one leg abutting against the other housing member when this is approached to the previous one.

This known device presents the disadvantage of the lack of preload and, as a consequence, it is not able to exert a minimum contact force for its total operative arch (of deformation). That's why the contact pressure is inferior to that minimum necessary for an appreciable initial stroke of the complete travel.

The aim of the present invention is to overcome the disadvantages and limitations illustrated before, and in particular to realize an electromagnetic shielding device which functioning should not be sensible to dimensional variations of the housing members on which it will be mounted, and which total spring modulus should be variable in an extremely easy way at the moment of its manufacturing.

Disclosure of Invention

According to the invention, these aims are reached through an electromagnetic shielding device between housing members for electronic equipment, which is formed by a contact spring with two legs, one pushing in an elastic way against the other and being able to clasp the edge of one of the housing members engaging itself permanently by means of at least one flap, created and bent-in on one leg, which engages in an aperture provided on the housing member,

characterized by the fact that these said legs are linked by a portion consisting of a circumference arc of more than 180°, that the second of these said legs is substantially flat, while the first of the said legs includes two flat aligned parts (stretches), and an

intermediate buckled portion forming an undercut which holds the end of the other leg, when the spring is not applied, the total length of the first leg being substantially more important than that of the second one.

Additional advantageous characteristics are the subject of the dependent claims.

Now the invention will be described referring to the enclosed designs illustrating favourite but not limiting realization forms of the invention, where:

Brief Description of Drawings

Fig. 1 illustrates in perspective a favourite realization form of the spring which constitutes the electromagnetic shielding device according to the present invention;

Fig. 2 is a lateral view of the spring shown in Fig. 1;

Fig. 3 illustrates a spring according to the invention set up on the edge of a sheet metal;

Fig 4 illustrates some springs fixed on an edge of sheet metal;

Fig. 5A and 5B show the functioning of the spring which makes up the electromagnetic shielding device according to the present invention; and

Fig. 6 shows an application of the "deep-set" type of the electromagnetic shielding device according to the present invention.

Referring in particular to figures 1 and 2, the electromagnetic shielding device according to the invention is made up by a spring 10, in lead material, including one major leg 1 provided with a strain forming a recess 6 and with a total length L1, one leg substantially flat 2 with a length L2 inferior to L1, and a curved junction portion shaped like a circumference arc with a radius R.

Spring 10 is obtained by the strain of a metallic foil, for example of steel.

The free edge of the short leg 2 ends in 2 flaps 5 made up by shearing and inside bending and which abut when the spring is at rest inside of recess 6 of the long leg 1.

As shown in figures 1 and 2 the strain of the major side is preferably obtained by three bendings of the metallic foil which form a V-shape portion between the initial stroke 1A and the final one 1B of leg 1 which substantially lie on the same plane. Between this plane, considered as the plane of leg 1, and the plane which contains substantially leg 2, an angle α is differentiated (when at rest).

The two legs of the spring are linked to portion 4 in such a way that they turn out to be tangents to the circumference in the transition point (points P and Q in figure 2).

Referring in particular to Fig. 2, the curved portion 4 extends for a circumference arc A of more than 180°, and by preference between 220° and 250°. The angle α formed between the legs 1 and 2 is between 35° and 60°, while the angle β formed between the flaps 5 and leg 2 is between 70° and 100°.

The difference of length (L1 - L2) between the legs 1 and 2 is at least equal to 20% of the long leg 1. The characteristics of the elastic yielding of the spring depend to a good extend on the length of the major leg 1 or on the relation between the length of both legs, and therefore, varying the extension of such leg it is possible to adjust easily and quickly the characteristics of the spring according to the needs of application. Such modification can be realized the manufacturing, or even at the moment of installation (by shortening part 1B), and preferably based on previously prepared tables which link the length of leg 1 to the thickness of the part on which the spring will be applied, and even to other geometric parameters of the housing.

Preferably as shown in figures 1 and 2, there have been created two ribs 14 on the circumference arc 4, which are obtained during the pressing of the spring, by deforming towards the inner side of the arc two circumference stripes. Such ribs oppose the elastic return of the material and assure the wanted inclination of leg 2 referring to leg 1 (angle α).

As shown in figures 1 and 2, when the spring is at rest and not applied to the edge of a component to be shielded, it has a rest configuration, in which flap 5 is seated in recess 6, getting in this way the settled preload whenever the spring is fitted on the housing edge. This preload has to be determined in a way to assure the minimum electric contact between the parts as soon as the spring is stressed and leg 1 is detached from the edge, as shown in details in figures 5 and 6. In this way we get the maximum usable work space of the spring, which is equal to the internal diameter of the curved part 4 less the thickness of the housing edge. Besides this the ribs 14 make the spring more rigid in order to prevent it from opening and losing so the preload, when the fixing tool is taken away.

The figures 3 and 4 show the application of some springs according to the invention to the metallic wall of a housing member 8. More precisely figure 4 is the view from above of some springs 10 mounted on a sheet metal edge 8, and figure 3 shows at an enlarged scale and in profile a spring applied to a housing edge 8.

Referring in particular to figure 3 the housing member 8 is provided with an aperture 7 in which the flaps 5 of the short leg enter so that the spring gets blocked in the wanted position, while the parts 1A and 1B of the long leg 1 remain adherent to wall 8 under the condition of an applied but not stressed spring. The distance t between two adjacent springs (see figure 4) depends on the frequency the shielding effect is wanted for.

The figures 5A and 5B show the functioning of the spring according to the invention shown when applied to a wall 11 with two different types of closure. In the rest position, that means when the cabinet is open, the configuration of the spring is indicated by a solid line design. When one of the doors, a mobile shutter or a wall 9, will be closed by a movement in the direction of arrow F1 or F2, the spring assumes the configuration shown by a broken line, with the short leg lying down on the housing wall 11 and the long leg 1 drawing away from it revolving with respect to such edge. As shown in the figure also the free end of leg 1 changes position compared to that before the closure.

Thanks to the configuration of the spring according to the invention, this cannot be deformed accidentally beyond the elastic field while engaged, as the same housing edge on which it is fixed acts as a retainer.

Figure 6 shows an application of the re-entrant type of spring according to the invention. The spring according to the invention is set up in such a way that it abuts an internal portion of wall 12, thanks to a gate or slit 13 created in an internal position and withdrawn with respect to the positioning apertures 7. The functioning of the spring illustrated in broken lines is analogous to that of the previous figures 5A and 5B.

The dimensions of the spring according to the invention vary in function of the housings dimensions they are assigned to, of the electromagnetic frequencies to be shielded and of the used materials. For the protection of telecommunication equipment the spring should be approximately 10 - 20 mm long and about 0.10 - 0.30 mm thick using austenitic steel NiCr.

Although the invention has been illustrated referring to a particular case, it can be applied in general to other housing structures, as the technician experienced in the field know.

CLAIMS

1. Electromagnetic shielding device between housing members for electronic equipment consisting of a contact spring with two legs (1, 2) which are driven in an elastic way one against the other, and suitable to embrace the edge (8, 11, 12) of one of the housing members, fitting permanently in an aperture provided in the housing member, by means of at least one lap (5), formed and bent-in on one leg, which engages in an aperture (7) provided in the member of the housing,

characterized by the fact that the said legs (1, 2) are connected by a portion (4) created by a circumference arc A superior to 180°, that the second of the said legs (2) is substantially plane, while the first one (1) consists of two aligned plane parts (1A, 1B) and an intermediate deformed part in order to create a recess (6) which holds the end of the other leg (2) of the non applied spring, the total length (L1) of the first leg (1) being substantially superior to that (L2) of the second leg (2).

2. Electromagnetic shielding device according to claim 1, characterized by the fact that the recess (6) of the said longer leg (1) is obtained by three foldings of the spring's metal foil creating a V-shaped portion between the initial part (1A) and the final one (1B) of the same leg, which lie substantially in one same plane.

3. Electromagnetic shielding device according to claims 1 and 2 characterized by the fact that on the said circumference arc shaped portion (4) circumference ribs (14) are created by buckling two circumference stripes towards the inner side of the arc.

4. Electromagnetic shielding device according to claim 3, characterized by the fact that the difference in length (L1 - L2) between the said legs (1, 2) is at least equal to 20% of the length of the first leg (1).

5. Electromagnetic shielding device according to claim 1, characterized by the fact that said circumference arc (A) is between 220° and 250°.

6. Electromagnetic shielding device according to claim 1, characterized by the fact that the said legs (1, 2) are tangents to the said circumference arc (4).

7. Electromagnetic shielding device according to the previous claims, characterized by the fact that between the plane which contains the second leg (2) and that which contains the initial (1A) and the final (1B) parts of the first leg (1) is defined an angle α between 35° and 60°.

8. Electromagnetic shielding device according to the previous claims, characterized by the fact that the said at least one lap (5) is bent-in according to an angle (ß) between 70° and 100° compared to the leg (2) on which it is created.

Fig.1

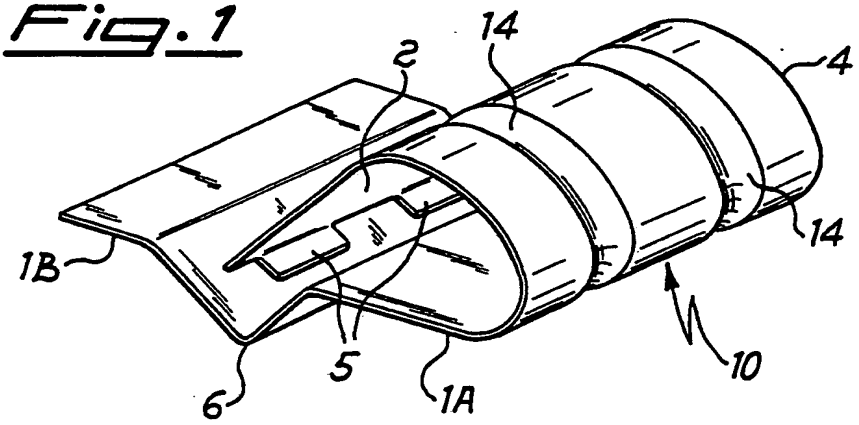


Fig.2

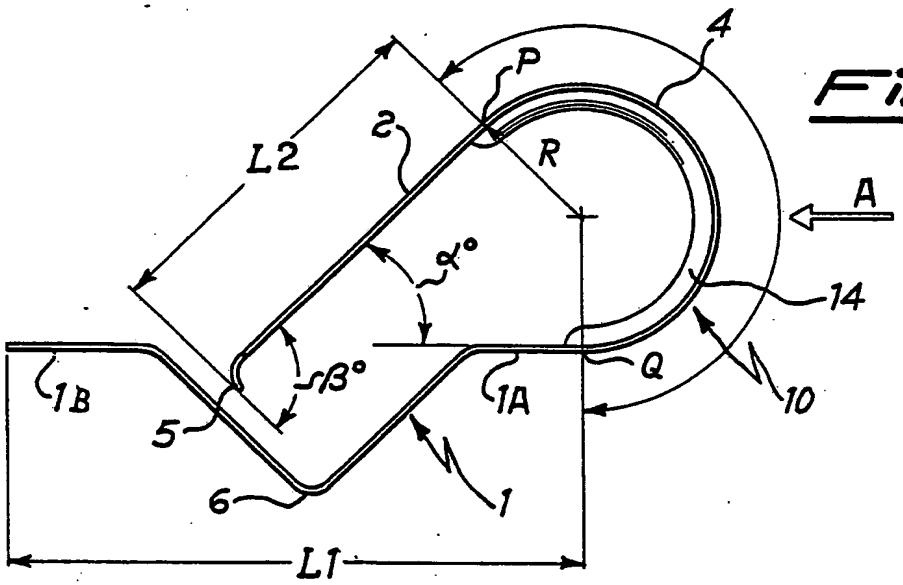


Fig.3

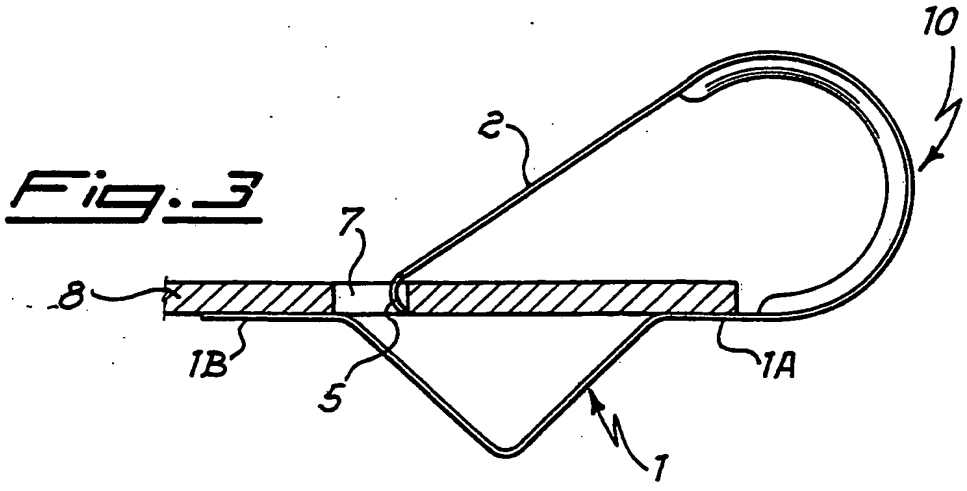


Fig.4

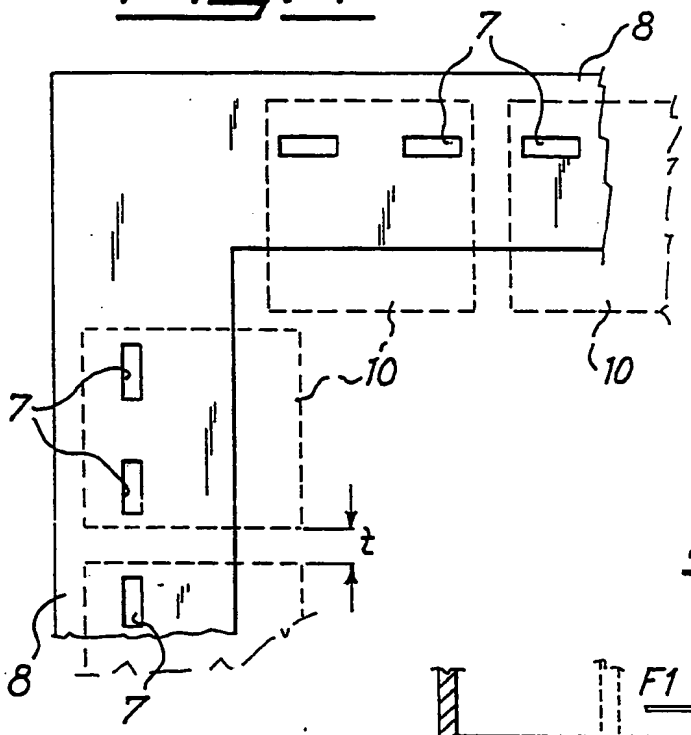


Fig.5A

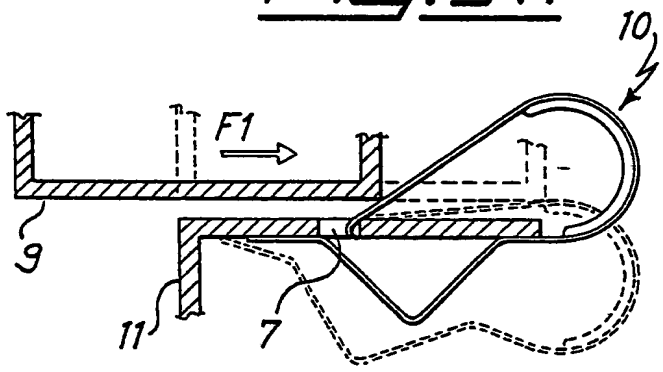


Fig.5B

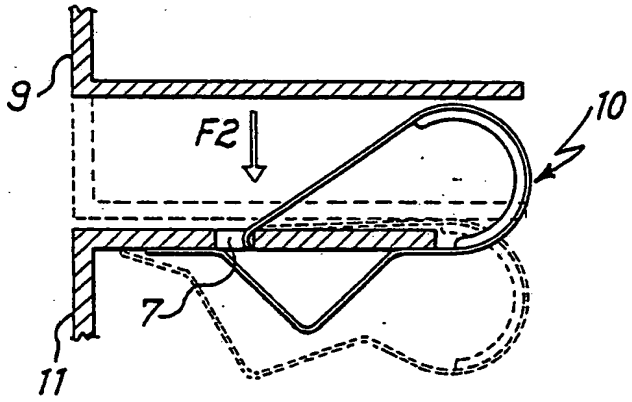
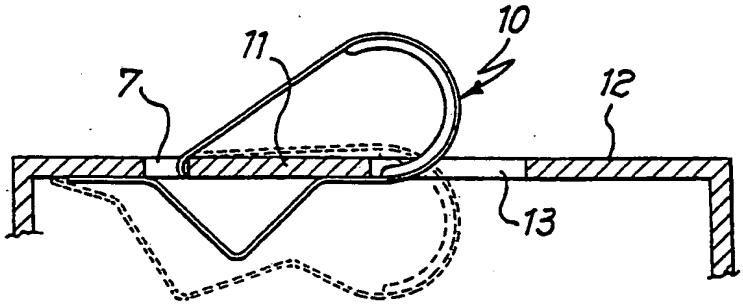


Fig.6



INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 93/00680

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 H05K9/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	H05K

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	DE,U,9 106 955 (SIEMENS) 10 October 1991 see the whole document	1-3
A	WO,A,8 601 069 (STANDARD ELEKTRIK LORENZ AG) 13 February 1986 see the whole document	1
A	EP,A,0 447 942 (SIEMENS NIXDORF INFORMATIONSSYSTEME AG) 25 September 1991 see the whole document	1
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
22 JUNE 1993	25. 06. 93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	TOUSSAINT F.M.A.

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

EP 9300680
SA 71853

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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